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LIST OF SPECIES

Check List 13(2): 2063, 11 March 2017 doi: https://doi.org/10.15560/13.2.2063
ISSN 1809-127X © 2017 Check List and Authors

Fish species (Osteichthyes: Actinopterygii) from two tributaries of the Rio do Peixe basin, Tupã municipality, São Paulo state, Brazil

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Abstract: The Rio Pitangueira and the Ribeirão Santa Terezinha are right margin affluents of the Rio do Peixe, upper Rio Paraná basin, São Paulo state, Brazil. Fourteen non-temporally standardized samplings were made at four sampling sites along the Rio Pitangueira and at one sampling site on Ribeirão Santa Terezinha using cast nets, trawl net, hand net, and fishing rod and hook. Thirty fish species were collected, belonging to five orders, 13 families, and 25 genera. Of these, one is probably new to science and one is a rare species.

Key words: diversity; freshwater fish; ichthyofauna; Neotropical river; rare species

INTRODUCTION

The upper Rio Paraná basin hosts more than 300 fish species (Langeani et al. 2007), 29–39% of which are endemic (Abell et al. 2008). The Rio do Peixe is an important tributary of the Rio Paraná in São Paulo state, and has a drainage area of about 10,769 km² (Mantovani et al. 2013). The Rio do Peixe sub-basin is located on the Marília-Exaporã plateau (Almeida 1964); this plateau is a part of the Paulista Western Highland, delimited by the Rio Aguapeí basin to the north and by the Rio Paranapanema basin to the south (Moraes Rêgo 1932). The headwaters of the Rio do Peixe are located in the Serra dos Agudos, at an elevation of 670 m (Mantovani et al. 2013).

The Comitê das Bacias Hidrográficas dos rios Aguapeí e Peixe (CBHAP 2007), assessed the status of the Rio Aguapeí and the Rio do Peixe watershed, and concluded that the Rio do Peixe was suffering from an intense erosive process, mainly due to removal of the marginal vegetation (almost all original vegetation has been removed: 8% remains) by agricultural activity and extensive livestock farming. This situation highlights the need for biodiversity studies of this environment. Therefore in this paper we aim to fill the knowledge gaps that exist concerning the fish fauna of this important basin. This is the first study evaluating the ichthyofauna of two right margin affluents (Rio Pitangueira and Ribeirão Santa Terezinha) of the Rio do Peixe basin in Tupã municipality, São Paulo state, Brazil.

MATERIAL AND METHODS

Study area

The Rio do Peixe lies approximately between the coordinates 21°33′S to 22°19′S and 049°41′W to 051°54′W. Approximately 380 km in length, the Rio do Peixe crosses 26 municipalities and discharges its waters into the Rio Paraná (Mantovani et al. 2013). It is considered a shallow river, with a maximum depth of 2 m, it has floodplain areas, and a very sinuous riverbed for its entire course (Trivellato & Filho 2012).

The western region of São Paulo state, where Tupã municipality is located, is a strongly degraded area with an extensive conversion of natural habitats to cattle pastures and sugar cane cultures. The Rio Piangueira and the Ribeirão Santa Terezinha are tributaries of the Rio do Peixe, in the upper Rio Paraná basin. Both rivers run northeast–southwest and debouch into the Rio do Peixe. The headwater of the Rio Pitangueira is near Herculândia municipality, São Paulo state, and all but 30 km of its total course lies within the municipality of Tupã. The headwater of the Ribeirão Santa Terezinha is near the urban area of Tupã city and its 21-km course lies entirely within this municipality.

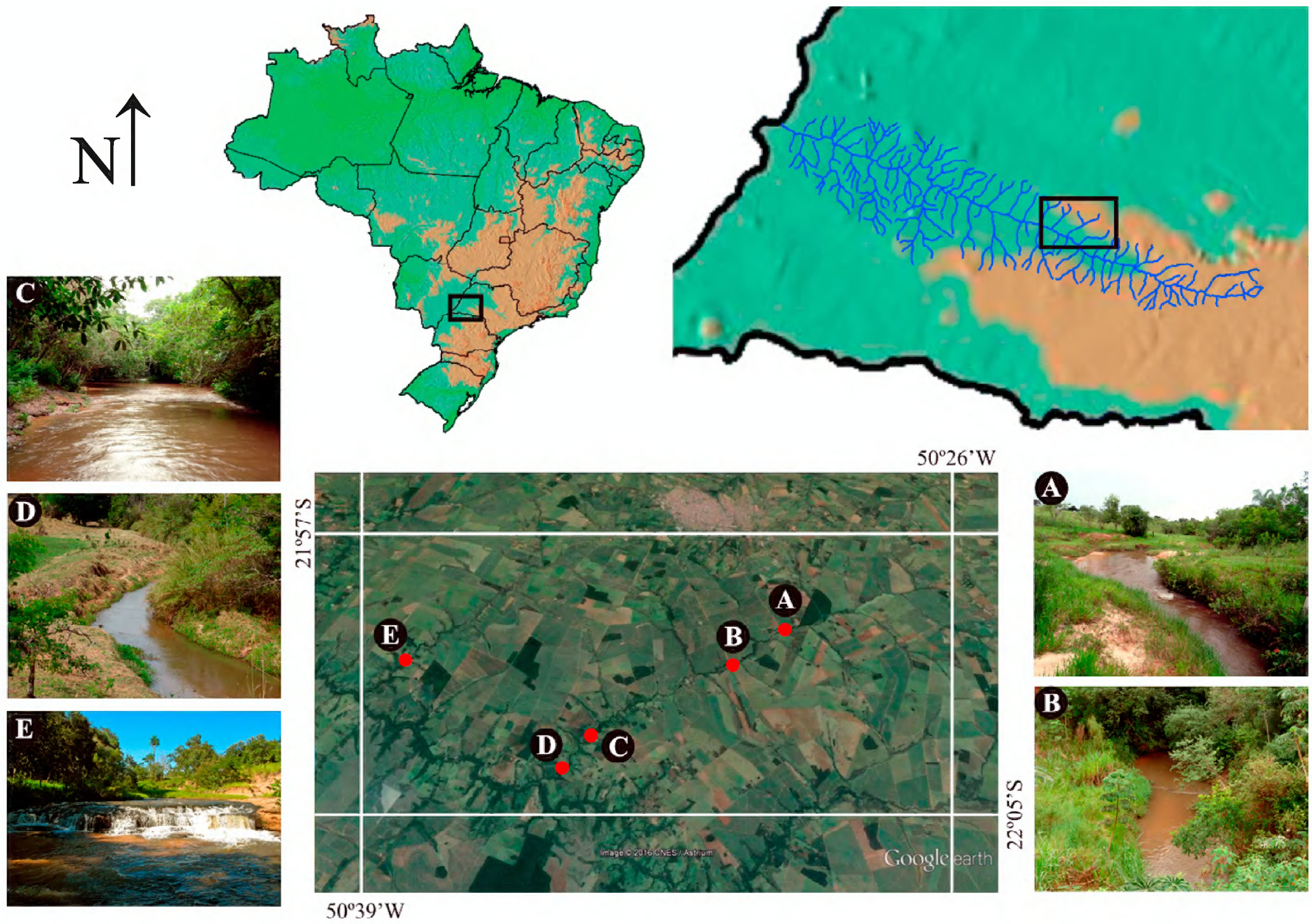

Figure 1. Map and habitat photos of the study area showing the collecting sites (red dots) in the Rio do Peixe basin, São Paulo state, Brazil (made using Quantum GIS Software). Rio Pitangueira (A, B, C and D); Ribeirão Santa Terezinha (E).

Data collection

Four sites were sampled on the Rio Pitangueira and one on the Ribeirão Santa Terezinha (Figure 1). Abiotic data, including water flow, transparency, structure of the substrate and riparian vegetation, were recorded *in situ* (Table 1). Fourteen non-temporally standardized samplings were made. Fish sampling was conducted under IBAMA collecting permit number 27410, and was performed using standard ichthyological gear used for active capture: cast nets, trawl nets, hand nets and a fishing rod with hooks. Specimens were euthanized in benzocaine and fixed in 10% formalin solution, then transferred to 70% ethanol. Identification was made using keys in Castro et al. (2004), Graça & Pavanelli (2007), and/or via expert verification. Taxonomic classification follows Eschmeyer & Fong (2016). Voucher specimens were deposited at the Coleção Ictiológica do Nupélia (NUP) of the Universidade Estadual de Maringá, Maringá, Paraná state and the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas state, Brazil (Appendix).

RESULTS

A total of 406 specimens were collected of 30 fish species belonging to five orders, 13 families and 24 genera (Figure 2; Table 2). The most species-rich orders were Characiformes

Table 1. Sampling sites located on the Rio Pitangueira (A, B, C and D) and Ribeirão Santa Terezinha (E), upper Rio Paraná basin, Tupã, São Paulo state, Brazil.

Site	Latitude	Longitude	Description of the site
A	22°00′22.9″ S	050°29′5.2″ W	Current slow to medium. Water clarity low. Substrate sand and some rock. Margin poorly vegetated on both sides.
B	22°01′24.46″ S	050°30′31.5″ W	Current medium to fast. Water clarity low. Substrate gravel and sand. Margin poorly vegetated on left bank and moderate on the right.
C	22°03′13.12″ S	050°33′43.17″ W	Current medium to fast. Water clarity low. Substrate rock, gravel and sand. Riparian vegetation preserved on both margins.
D	22°03′59″ S	050°34′19″ W	Current medium to fast. Water clarity low. Substrate sand. Margin poorly vegetated on left side and moderate on the right.
E	22°01′17.2″ S	050°38′19.2″ W	Current fast. Water clarity medium. Substrate rock and sand. Riparian vegetation preserved on right margin and poorly vegetated on left side.

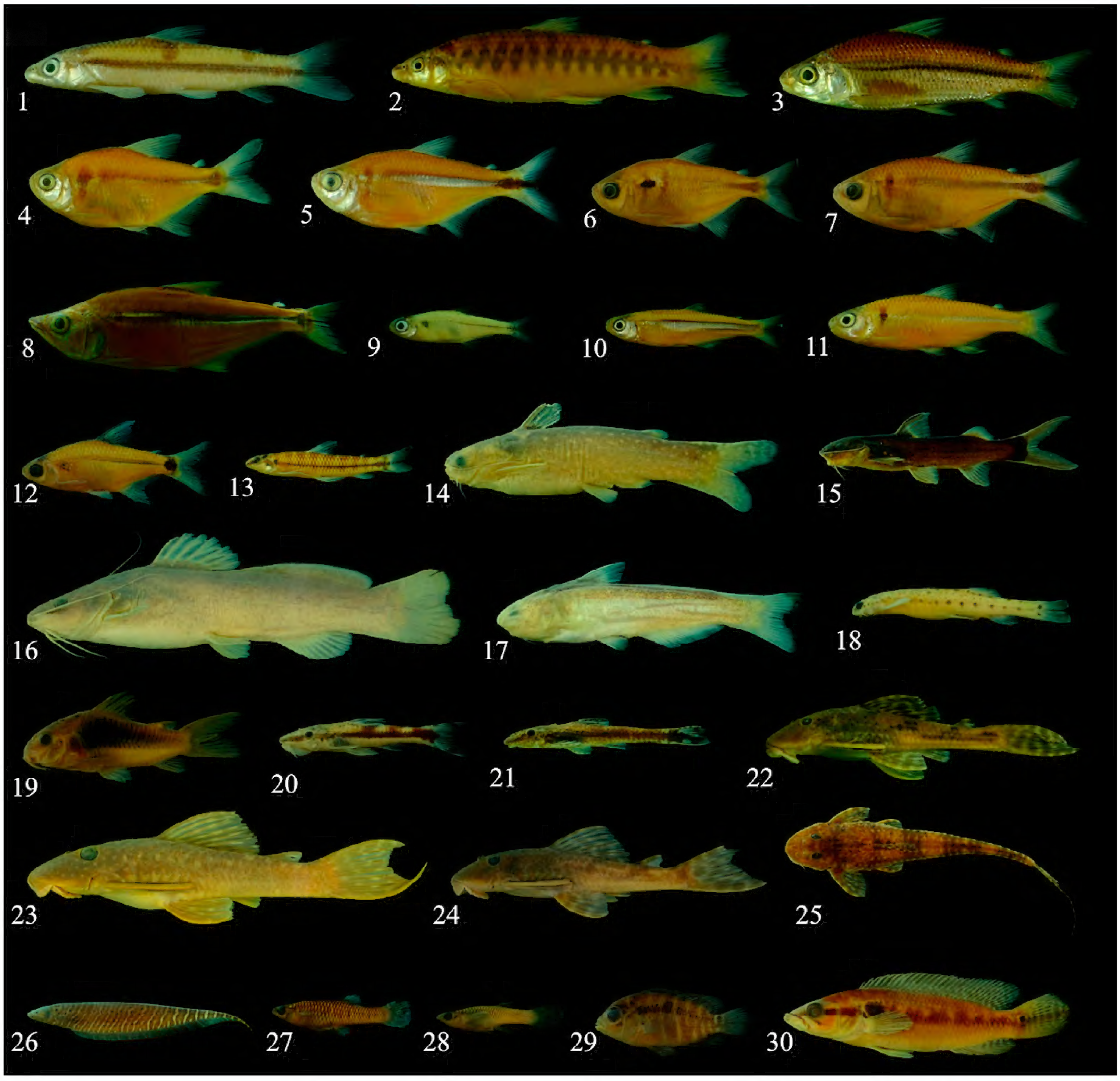

Figure 2. Fishes of Rio Pitangueira and Ribeirão Santa Terezinha, tributaries of the Rio do Peixe basin. **1.** *A. piracicabae*, NUP 7016, 42.6 mm SL. **2.** *P. nasus*, NUP 5188, 86.4 mm SL. **3.** *S. insculpta*, NUP 7019, 88.8 mm SL. **4.** *A. bockmanni*, NUP 7041, 54.5 mm SL. **5.** *Astyanax* aff. *fasciatus*, NUP 11952, 65.1 mm SL. **6.** *A. lacustris*, NUP 14422, 49.8 mm SL. **7.** *Astyanax* aff. *paranae*, NUP 14425, 67.5 mm SL. **8.** *G. knerii*, NUP 7018, 114.8 mm SL, **9.** *Odontostilbe* sp., NUP 12384, 19.7 mm SL. **10.** *P. stramineus*, NUP 12382, 47.9 mm SL. **11.** *P. argentea*, NUP 12391, 54.6 mm SL. **12.** *S. notomelas*, NUP 14409, 31.2 mm SL. **13.** *Characidium* aff. *zebra*, NUP 11946, 53.0 mm SL. **14.** *T. neivai*, NUP 12381, 63.1 mm SL. **15.** *C. iheringi*, NUP 11948, 55.4 mm SL. **16.** *R. quelen*, NUP 7020, 140.1 mm SL. **17.** *C. gobioides*, NUP 7040, 61.1 mm SL. **18.** *P. paulensis*, NUP 12383, 32.8 mm SL. **19.** *C. aeneus*, NUP 14410, 35.3 mm SL. **20.** *C. insperatus*, NUP 11858, 26.6 mm SL. **21.** *H. francirochai*, NUP 7037, 30.7 mm SL. **22.** *H. ancistroides*, NUP 7044, 87.9 mm SL. **23.** *H. strigaticeps*, NUP 6475, 135.2 mm SL. **24.** *H. topavae*, NUP 14419, 82.6 mm SL. **25.** *R. latirostris*, NUP 14427, 93.3 mm SL. **26.** *G. inaequilabiatus*, NUP 11947, 123.6 mm SL. **27.** *P. harpagos*, NUP 14421, 36.7 mm SL. **28.** *P. reticulata*, NUP 14417, 18.6 mm SL. **29.** *C. paranaense*, NUP 11954, 47.3 mm SL. **30.** *C. britskii*, NUP 7046, 86.5 mm SL.

and Siluriformes (Figure 3), representing 83% of the total richness. Characidae was the most represented family, followed by Loricariidae (Figure 4), together summing 50% of all species. Nine species were found exclusively at site D: *Apareiodon piracicabae* (Parodontidae), *Cetopsis gobioides* (Cetopsidae), *Cichlasoma paranaense* (Cichlidae), *Crenicichla britskii* (Cichlidae), *Galeocharax knerii* (Characidae), *Hisonotus francirochai* (Loricariidae), *Pseudostegophilus paulensis* (Trichomycteridae), *Steindachnerina insculpta* (Curimatidae) and *Tatia neivai* (Auchenipteridae). Three species were found exclusively at site E: *Cetopsorhamdia iheringi* (Heptapteridae), *Characidium* aff. *zebra* (Crenuchidae) and *Gymnotus inaequilabiatus* (Gymnotidae). Finally, *Poecilia reticulata* (Poeciliidae) was found exclusively at site A, *Corydoras aeneus* (Callichthydae) exclusively at site B, and *Phalloceros harpagos* (Poeciliidae) exclusively at site C.

Of the four most common species, *Hypostomus strigaticeps* (Loricariidae) was the most abundant with 99 specimens, approximately 25% of all specimens collected, followed by *Piabina argentea* (Characidae, 67 specimens, 16%), *Hypostomus topavae* (Loricariidae, 44 specimens, 11%) and *Piabarchus stramineus* (Characidae, 33 specimens, 8%). Site D had the highest species richness (22 species) and abundance (165 specimens). Three of the captured species have recently changed taxonomic status: *Astyanax altiparane* (Characidae) was considered a junior synonym of *A. lacustris* by Lucena & Soares (2016); *Pseudostegophilus paulensis* was returned to the originally described genus (DoNascimiento 2015), and two species have received new generic allocations: *Bryconamericus stramineus* (Characidae) placed in *Piabarchus* by Thomaz et al. (2015) and *Hisonotus insperarus* (Loricariidae) to *Curculionichthys* by Roxo et al.

Table 2. List of species recorded in the Rio Pitangueira and Ribeirão Santa Terezinha, tributaries of the Rio do Peixe, upper Rio Paraná basin, Tupã municipality, São Paulo state, Brazil. Sampling sites: A, B, C and D in Rio Pitangueira (P) and E in Ribeirão Santa Terezinha (ST). *N*: total of specimens.

Class/order/family/species	P				ST	*N*
	A	B	C	D	E	
Actinopterygii						
Characiformes						
Parodontidae						
Apareiodon piracicabae (Eigenmann, 1907)	-	-	-	16	-	16
Parodon nasus Kner, 1859	1	-	-	-	8	9
Curimatidae						
Steindachnerina insculpta (Fernández-Yépez, 1948)	-	-	-	1	-	1
Characidae						
Astyanax bockmanni Vari & Castro, 2007	-	-	1	4	-	5
Astyanax aff. *fasciatus* (Cuvier, 1819)	2	-	2	16	-	20
Astyanax lacustris (Lütken, 1875)	2	-	1	1	2	6
Astyanax aff. *paranae* Eigenmann, 1914	6	-	3	-	-	9
Galeocharax knerii (Steindachner, 1879)	-	-	-	2	-	2
Odontostilbe sp.	-	-	-	13	-	13
Piabarchus stramineus (Eigenmann, 1908)	-	-	19	12	2	33
Piabina argentea Reinhardt, 1867	-	-	12	49	6	67
Serrapinnus notomelas (Eigenmann, 1915)	1	1	-	3	-	5
Crenuchidae						
Characidium aff. *zebra* Eigenmann, 1909	-	-	-	-	3	3
Siluriformes						
Auchenipteridae						
Tatia neivai (Ihering, 1930)	-	-	-	7	-	7
Heptapteridae						
Cetopsorhamdia iheringi Schubart & Gomes 1959	-	-	-	-	13	13
Rhamdia quelen (Quoy & Gaimard, 1824)	-	-	-	1	1	2
Cetopsidae						
Cetopsis gobioides Kner, 1858	-	-	-	1	-	1
Trichomycteridae						
Pseudostegophilus paulensis Miranda Ribeiro, 1918	-	-	-	2	-	2
Callichthydae						
Corydoras aeneus (Gill, 1858)	-	3	-	-	-	3
Loricariidae						
Curculionichthys insperatus (Britski & Garavello, 2003)	-	6	-	11	-	17
Hisonotus francirochai (Ihering, 1928)	-	-	-	3	-	3
Hypostomus ancistroides (Ihering, 1911)	3	-	-	9	3	15
Hypostomus strigaticeps (Regan, 1908)	-	4	4	1	90	99
Hypostomus topavae (Godoy, 1969)	-	-	4	9	31	44
Rineloricaria latirostris (Boulenger, 1900)	-	-	3	1	-	4
Gymnotiformes						
Gymnotidae						
Gymnotus inaequilabiatus (Valenciennes, 1839)	-	-	-	-	1	1
Cyprinodontiformes						
Poecillidae						
Phalloceros harpagos Lucinda, 2008	-	-	1	-	-	1
Poecilia reticulata Peters, 1859	1	-	-	-	-	1
Perciformes						
Cichlidae						
Cichlasoma paranaense Kullander, 1983	-	-	-	2	1	3
Crenicichla britskii Kullander, 1982	-	-	-	1	-	1

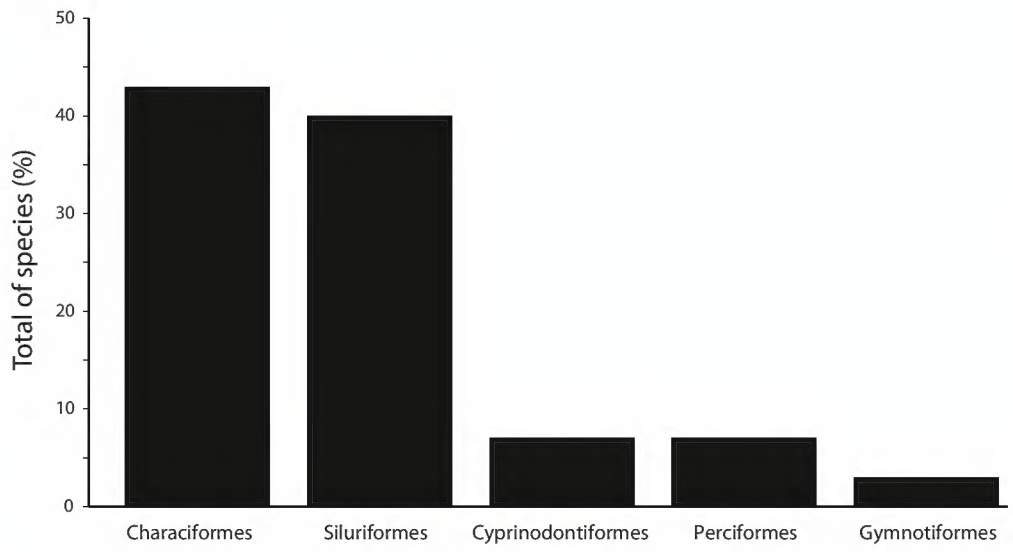

Figure 3. Percentages of the total of species for each order recorded in the two tributaries of Rio do Peixe basin, Brazil.

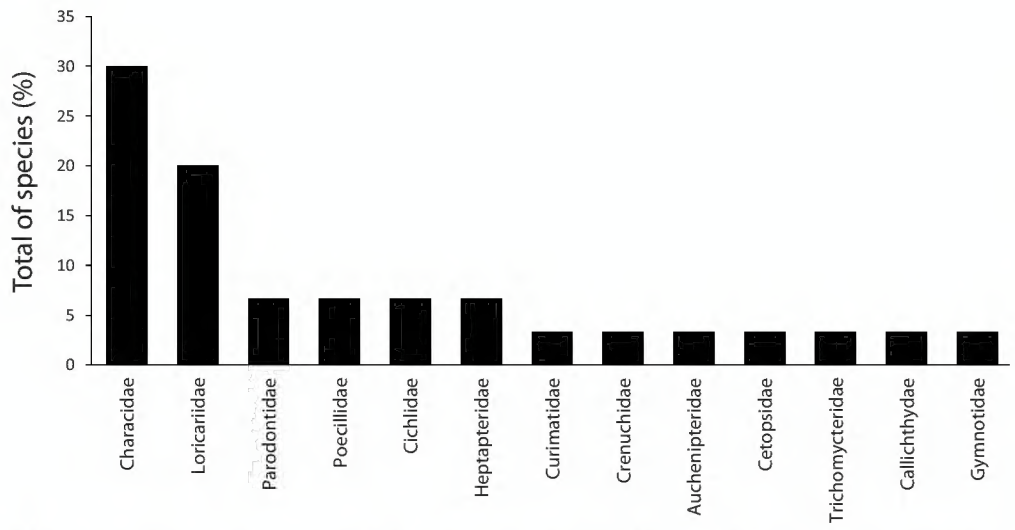

Figure 4. Percentages of the total of species for each family recorded in the two tributaries of Rio do Peixe basin, Brazil.

(2015). An identification key of all species captured is given in the appendix. Short descriptions of some captured species are provided below.

Apareiodon piracicabae (Eigenmann, 1907)
Pareiodon piracicabae Eigenmann *in* Eigenmann & Ogle (1907): 6
Apareiodon piracicabae — Graça & Pavanelli (2007): 26, 28; Hoffmann et al. (2015): 4, figure A1.C

One row of teeth on premaxilla; two teeth on maxilla; dentary margin straight and lacking teeth; one unbranched pectoral-fin ray; longitudinal stripe on lateral body.

Astyanax bockmanni Vari & Castro, 2007
Astyanax bockmanni Vari & Castro (2007): 150, 151, Fig. 1
Astyanax sp. — Castro et al. (2004): 32, figure 4a–7
Astyanax bockmanni — Graça & Pavanelli (2007): 54, 56; Hoffmann et al. (2015): 4, figure A1.F

Two rows of teeth on premaxilla, the inner row with five teeth; maxillary teeth present; lateral line complete; caudal fin not covered by scales; a distinctly vertically-elongate humeral mark; body depth more than 40% of the standard length.

Astyanax* aff. *fasciatus (Cuvier, 1829)
Chalceus fasciatus Cuvier (1819): 352, pl. 26
Astyanax fasciatus — Castro et al. (2004): 32, figure 4a–5
Astyanax aff. *fasciatus* — Graça & Pavanelli (2007): 54, 57

Two rows of teeth on premaxilla, the inner row with five teeth; maxillary teeth present; lateral line complete, caudal fin not covered by scales; a distinct vertically-elongate humeral mark present; body depth less than 30% of standard length; anal fin with more than 24 branched rays.

Astyanax lacustris (Lütken, 1875)
Tetragonopterus lacustris Lütken (1875): 131
Astyanax scabripinnis — Castro et al. (2004): 32, figure 4a
Astyanax altiparanae — Graça & Pavanelli (2007): 54, 55; Hoffmann et al. (2015): 4, figure A1.E
Astyanax lacustris — Lucena & Soares (2016): 103, figures 1, 6, 8, 9

Two rows of teeth on premaxilla, the inner row with five teeth; maxillary teeth absent; lateral line complete; caudal fin not covered by scales; a distinct horizontally-oval humeral spot.

Astyanax* aff. *paranae Eigenmann, 1914
Astyanax scabripinnis paranae Eigenmann (1914): 47
Astyanax scabripinnis — Castro et al. (2004): 32, figure 4a–6
Astyanax aff. *paranae* — Graça & Pavanelli (2007): 54, 58

Two rows of teeth on premaxilla, inner row with five teeth; maxillary teeth present; lateral line complete; caudal fin not covered by scales; a distinctly vertically-elongate humeral mark; body depth less than 30% of standard length; anal fin with fewer than 24 branched rays.

***Odontostilbe* sp.**
Odontostilbe sp. — Graça & Pavanelli (2007): 21, 92

One rows of teeth on premaxilla; maxillary teeth present; lateral line complete; caudal fin not covered by scales; pseudotympanum present; a distinct longitudinal stripe on lateral body.

Piabarchus stramineus (Eigenmann, 1908)
Bryconamericus stramineus Eigenmann (1908): 105 — Castro et al. (2004): 32, figures 4a–8; Graça & Pavanelli (2007): 60, 62; Hoffmann et al. (2015): 4, figure A2.A
Piabarchus stramineus — Thomaz et al. (2014): 20, figure 10

Two rows of teeth on premaxilla, the inner row with four teeth; maxillary teeth present; lateral line complete; caudal fin not covered by scales; distal part of caudal fin with a hyaline margin; a distinct longitudinal stripe on lateral body; body shape elongate; body depth less than 25% of the standard length. The genus *Piabarchus* presents a long anal fin with origin opposite to/or slightly anterior to the dorsal fin origin. Recently, Thomaz et al. (2015), in their molecular phylogeny of the Stevardiinae, placed *Bryconamericus stramineus* in the genus *Piabarchus*. Therefore, *P. stramineus* can be distinguished from both *P. analis* (Eigenmann, 1914) and *P. torrenticola* Mahnert & Géry, 1988 by the having the anal-fin origin posterior to dorsal fin origin.

Pseudostegophilus paulensis Miranda Ribeiro, 1918
Pseudostegophilus paulensis Miranda Ribeiro (1918): 727 — Donascimiento (2015):
Parastegophilus paulensis — de Pinna & Wosiacki (2003): 277

Body elongate; head depressed; mouth inferior; numerous dainty teeth; spines present in both interopercle and opercle; fins hyaline; anal fin rays about seven; anal fin origin

posterior to dorsal fin; caudal fin bifurcated, with rounded lobes; body color yellow with rounded black spots.

Gymnotus inaequilabiatus (Valenciennes, 1839)
Carapos inaequilabiatus — Valenciennes (1839): 14
Gymnotus inaequilabiatus — Graça & Pavanelli (2007): 178, 179.

Body elongate and slightly compressed; head relatively long; mouth in a superior position; one or two conical teeth on premaxilla and dentary; body with 21 or 22 pairs of obliquely dark bands from tip of tail to nape; pectoral and anal fins uniformly dark gray; posterior region of anal fin pale gray.

DISCUSSION

In this study Characiformes and Siluriformes presented the greatest species diversity; these two orders are the dominant taxa in lotic environments of the upper Rio Paraná basin (Langeanni et al. 2007). In terms of richness the two most diverse Neotropical families (Characidae and Loricariidae) (Reis et al. 2003) had representatives at all sites and also showed the greatest number of collected specimens, a pattern also found by other studies on the upper Rio Paraná basin fish fauna (e.g., Maier et al. 2008; Castro et al. 2004; Oyakawa & Menezes 2011; Delariva & da Silva 2013; Viana et al. 2013; Frota et al. 2016). The environments sampled included rapids interspersed with lentic areas and substrates that can be used for adhesion favoring fast swimmers such as *Piabina argentea* and *Piabarchus stramineus* and bottom dwellers that adhere to substrates with suckermouths such as *Hypostomus strigaticeps* and *H. topavae* (Ferreira et al. 2010).

The majority of the specimens collected are of small and medium size (15 cm or less). Such species represent a great part of species found in aquatic environments of low order, about 50% of all fish species described from such locations in South America (Castro 1999), and more than 65% of the species of the upper Rio Paraná basin (Langeani et al. 2007). Site D on the Rio Pitangueira showed the highest species richness and greatest abundance of specimens sampled, followed by the site E on the Ribeirão Santa Terezinha. These sites are near the respective mouths of these waterbodies and this may explain their great richness. Increase in species richness towards the mouth of tropical streams has been recorded in a number of other studies (Abes & Agostinho 2001; Bifi et al. 2006).

At the site D on the Rio Pitangueira a possibly undescribed species, *Odontostilbe* sp., and a rare species, *Pseudostegophilus paulensis*, were collected. According to SpeciesLink (CRIA 2016) there are only 12 known records of *P. paulensis*, in only five indexed zoological collections, confirming its rarity. For many rare species, extinction is often inevitable when local environments become unsuitable through habitat loss or modification (Thomas 1994). The aquatic biota is strongly threatened on a global scale by biological invasions and hydrological changes, which pose major threats to freshwater ecosystems (Johnson et al. 2008).

One female specimen of the exotic species *Poecilia reticulata* was captured, but it is likely that more could have been collected with a more intense sampling effort. Of all the species caught in this study, *P. reticulata* was the only non-native. It is the species of Poeciliidae most commonly caught in urban streams where it frequently coexists with native species, such as *Phalloceros harpagos* (Pagotto et al. 2012). Resistance and resilience are characters strongly exhibited by *P. reticulata*, as well as a high rate of reproduction (Gomiero & Braga 2007), and high efficient in colonizing a variety of aquatic environments (Reznick et al. 1996). The resulting ecological interactions can cause intense negative impacts on *P. harpagos* and other small species.

The ichthyofauna of São Paulo State has suffered irreversible damage from air and water pollution, removal of riparian vegetation, and construction of reservoirs for the production of electricity (Oyakawa & Menezes 2011). This situation reinforces the necessity to continue sampling efforts in every drainage of this region to provide a basis for present and future conservation goals.

ACKNOWLEDGEMENTS

We are deeply grateful to Dr. Adrian Benett for English review, as well as to Carla S. Pavanelli, Carlos A. de Oliveira, Cláudio H. Zawadzki, Gabriel Deprá, and Weferson J. da Graça for helping with the identification of some specimens. We also thank Nupélia (Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura of the Universidade Estadual de Maringá) for offering logistical support and for grants received of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). AGB was supported a postdoctoral fellowship (FAPEAM/CNPq Proc. 062.01066/2015).

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Authors' contributions: AGB collected the data; AGB, ACD, and AF took pictures and wrote the text.

Received: 27 October 2016
Accepted: 28 February 2017
Academic editor: Sarah Steele

APPENDIX

Identification key and list of voucher species examined in the present study followed by the catalog numbers in the Coleção Ictiológica do Nupélia (NUP) and Instituto Nacional de Pesquisas da Amazônia (INPA). All material is from the Rio Pitangueira and Ribeirão Santa Terezinha, tributaries of the Rio do Peixe, upper Rio Paraná basin.

Identification key to the fish species recorded in the two tributaries of Rio do Peixe basin

1a Anterior portion of dorsal and anal fins with one or more spines 2
1b Spine occasionally present on dorsal fin, always absent on anal fin 3

2a Body elongate, standard length 2.8 to 5.0 times greatest depth . . . . . *Crenicichla britskii*
2b Body deep, SL 1.7 to 2.5 times greatest depth . . . . . *Cichlasoma paranaense*

3a Body knife-shaped; anal fin with more than 100 rays; dorsal and pelvic fins absent . . . . . *Gymnotus inaequilabiatus*
3b Body not knife-shaped; anal fin with up to 62 rays; dorsal and pelvic fins present 4

4a Top of head flat and covered by scales 5
4b. Top of head not flat and lacking scales 6

5a Males and females with dark brown, transverse blotch on flank, beneath dorsal fin; adult males with long gonopodium, its length contained 2.6 to 3.1 times in SL . . . . . *Phalloceros harpagos*
5b Males irregularly multicolored, females without dark brown blotch on flank; adult males with short gonopodium, its length contained 3.2 to 3.6 times in SL . . . . . *Poecilia reticulata*

6a Body naked or covered by plates. 7
6b Body covered by scales 18

7a Body entirely naked, without plates. 8
7b Body covered by plates 12

8a Spines present in both interopercle and opercle . . . . . *Pseudostegophilus paulensis*
8b Spines absent in both interopercle and opercle 9

9a Adipose fin absent . . . . . *Cetopsis gobioides*
9b Adipose fin present. 10

10a Orbital margin covered by skin, without free margin . . . . . *Tatia neivai*
10b Orbital margin free, eye not covered by skin 11

11a First dorsal and pectoral fin rays hardened on its base, but not pungent . . . . . *Cetopsorhamdia iheringi*
11b First dorsal and pectoral fin rays developed into pungent spines . . . . . *Rhamdia quelen*

12a Two longitudinal series of plates on flank . . . . *Corydoras aeneus*
12b More than two longitudinal series of plates on flank 13

13a Caudal peduncle depressed . . . . . *Rineloricaria latirostris*
13b Caudal peduncle not depressed 14

14a Adipose fin absent 15
14b Adipose fin present. 16

15a Caudal fin hyaline with dark blotch limited to caudal peduncle base . . . . . *Curculionichthys insperatus*
15b Caudal fin hyaline with one dark stripe extending from caudal peduncle base to the middle caudal fin rays . . . . . *Hisonotus francirochai*

16a Body covered by light gray spots . . . . . *Hypostomus strigaticeps*
16b Body covered by dark brown spots. 17

17a Orbits small; abdomen completely covered by plates . . . . . *Hypostomus ancistroides*
17b Orbits large; abdomen with plates concentrated on its anterior portion . . . . . *Hypostomus topavae*

18a Premaxilla, maxilla and dentary entirely devoid of teeth . . . . . *Steindachnerina insculpta*
18b Premaxilla, maxilla or dentary with at least some teeth. 19

19a Dentary devoid of teeth, at least anteriorly 20
19b Dentary with teeth, even anteriorly. 21

20a Dentary devoid of lateral teeth. . . . . *Apareiodon piracicabae*
20b Dentary with lateral teeth . . . . . *Parodon nasus*

21a Body scales spinoid. . . . . *Galeocharax knerii*
21b Body scales cycloid 22

22a Pseudotympanum present. 23
22b Pseudotympanum absent 24

23a Lateral line complete . . . . . *Odontostilbe* sp.
23b Lateral line incomplete. . . . . *Serrapinnus notomelas*

24a Pectoral fin with three unbranched rays; anal fin with up to 9 rays . . . . . *Characidium* aff. *zebra*
24b Pectoral fin with one unbranched ray; anal fin with at least 17 rays 25

25a Premaxilla with 3 rows of robust teeth . . . . . *Piabina argentea*
25b Premaxilla with 2 rows of teeth 26

26a Inner row of premaxilla with 4 teeth . . . . *Piabarchus stramineus*
26b Inner row of premaxilla with 5 teeth 27

27a Humeral spot oval, horizontally elongated. . . *Astyanax lacustris*
27b Humeral spot vertically elongated 28

28a One humeral spot . . . . . *Astyanax* aff. *fasciatus*
28b Two humeral spots 29

29a Greatest body depth on vertical through middle of pectoral fin . . . . . *Astyanax* aff. *paranae*
29b Greatest body depth two scales anterior to dorsal fin origin . . . . . *Astyanax bockmanni*

Voucher specimens deposited in ichthyological collections

Voucher list: 406 specimens, all from Brazil, São Paulo State, Rio do Peixe basin. *Apareiodon piracicabae*. NUP 7016, NUP 7038; *Astyanax bockmanni*. NUP 7041, NUP 12389, NUP 14420; *Astyanax* aff. *fasciatus*. NUP 11952, NUP 12390, NUP 14424; *Astyanax lacustris*.

NUP 5187, NUP 6470, NUP 12385, NUP 14413, NUP 14422; *Astyanax* aff. *paranae*. NUP 14414, NUP 14416, NUP14425; *Cetopsis gobioides*. NUP 7040; *Cetopsorhamdia iheringi*. INPA 50861, NUP 5189, NUP 6469, NUP 11948; *Characidium* aff. *zebra*. NUP 11946; *Cichlasoma paranaense*. NUP 11945, NUP 11954; *Corydoras aeneus*. NUP 14410; *Crenicichla britskii*. NUP 7046; *Curculionichthys insperarus*. NUP 7039, NUP 11958, NUP 14408; *Galeocharax knerii*. NUP 7018, NUP 7043; *Gymnotus inaequilabiatus*. NUP 11947; *Hisonotus francirochai*. NUP 7037, NUP 11963; *Hypostomus ancistroides*. NUP 7044, NUP 11944, NUP 11957, NUP 14411; *Hypostomus strigaticeps*. INPA 50860, NUP 5185, NUP 6475, NUP 6493, NUP 7088, NUP 14418; *Hypostomus topavae*. INPA 50859, NUP 5184, NUP 6481, NUP 7017, NUP 7042, NUP 11949, NUP 12386, NUP 14419; *Odontostilbe* sp.. NUP 12384; *Parodon nasus*. NUP 5188, NUP 6479. NUP 14412; *Phalloceros harpagos*. NUP 14421; *Piabarchus stramineus*. NUP 6466, NUP 12382, NUP 11950, NUP 14423; *Piabina argentea*. NUP 6471, NUP 7015, NUP 7047, NUP 12391, NUP 14426; *Poecilia reticulata*. NUP 14417; *Pseudostegophilus paulensis*. NUP 7035, NUP 12383; *Rhamdia quelen*. NUP 5186. NUP 7020; *Rineloricaria latirostris*. NUP 7013, NUP 14427; *Serrapinnus notomelas*. NUP 7036, NUP 11960, NUP 14409, NUP 14415; *Steindachnerina insculpta*. NUP 7019; *Tatia neivai*. NUP 7014, NUP 7045, NUP 12381.